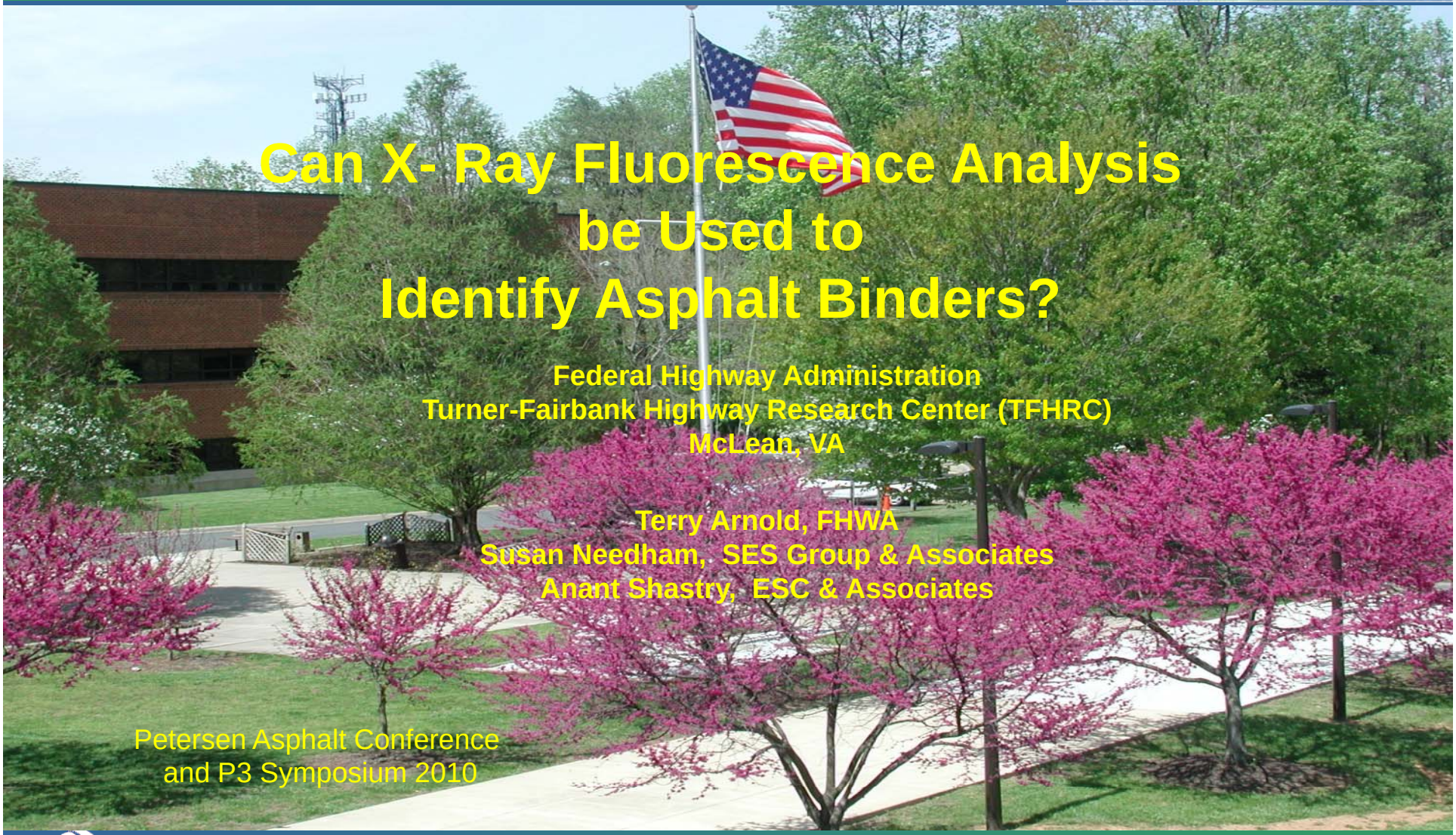
TURNER-FAIRBANK HIGHWAY RESEARCH CENTER



Can X- Ray Fluorescence Analysis be Used to Identify Asphalt Binders?

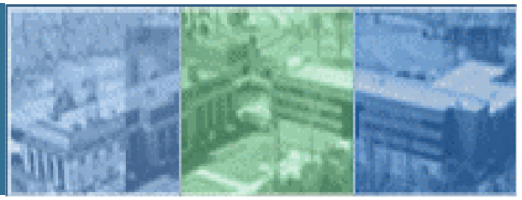
Federal Highway Administration
Turner-Fairbank Highway Research Center (TFHRC)
McLean, VA

Terry Arnold, FHWA
Susan Needham, SES Group & Associates
Anant Shastry, ESC & Associates

Petersen Asphalt Conference
and P3 Symposium 2010

Is this Binder What We Think It Is? Can XRF help?


X-Ray Fluorescence
is a simple technique for the
quantitative analysis of elements,
typically from Sodium to Uranium in
the Periodic Table.



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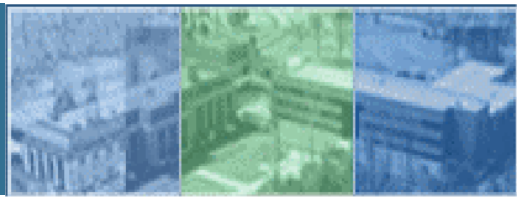
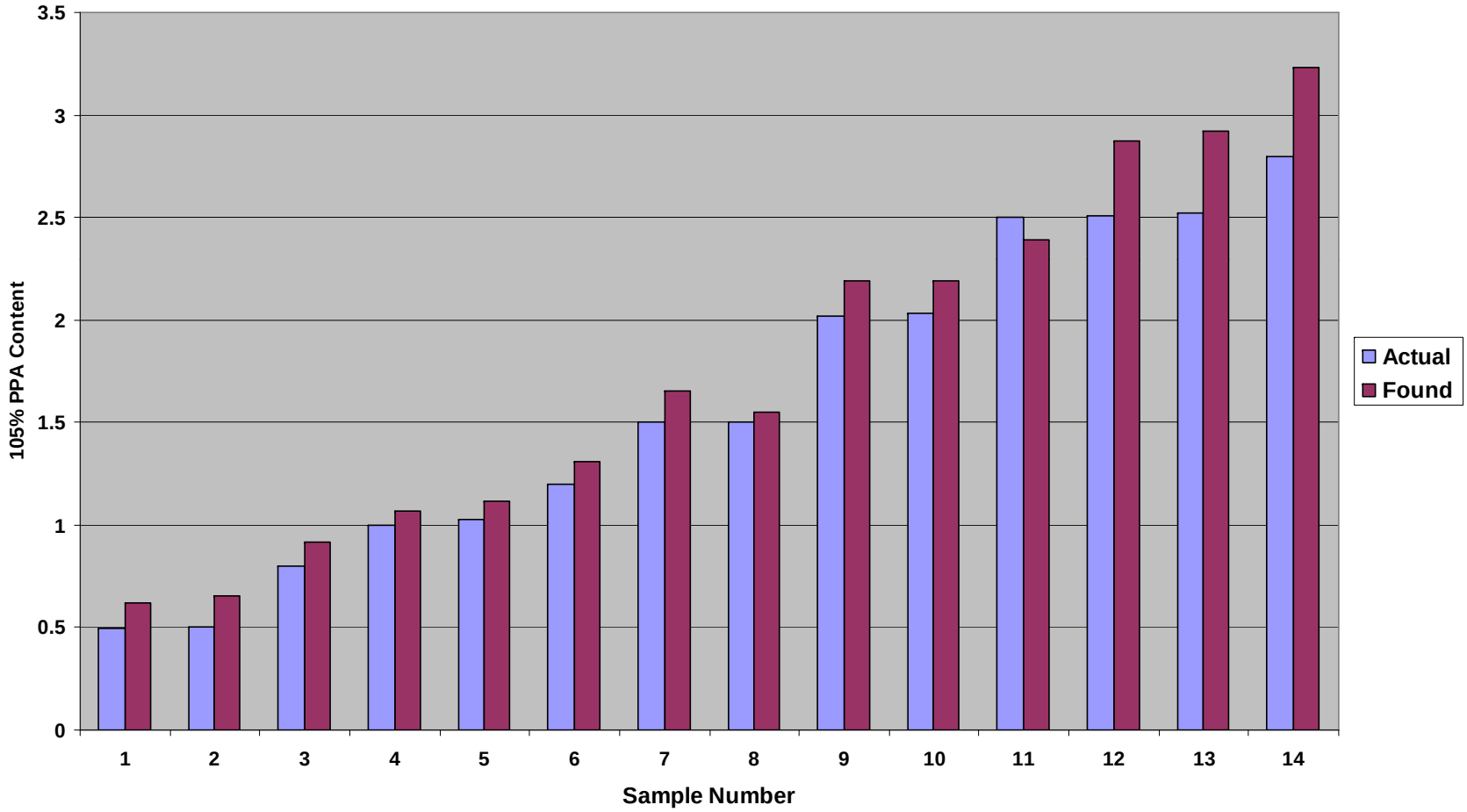


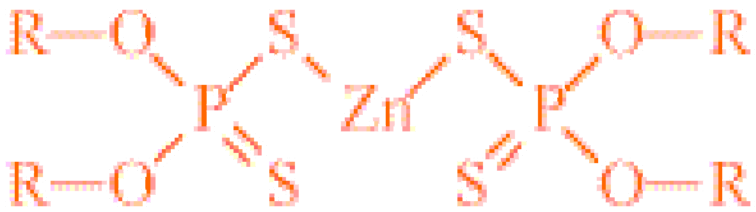
XRF Spectroscopy Can Detect:

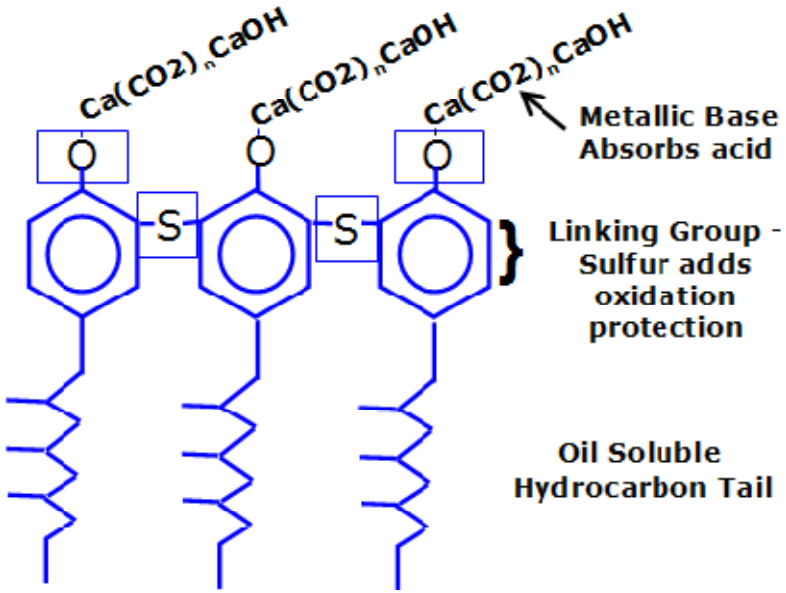
- Polyphosphoric Acid (PPA)
- Recycled Engine Oil Bottoms (REOB)
- Crumb Rubber Modified (CRM)
- Among Other Things

XRF Analysis of PPA Modified Asphalt

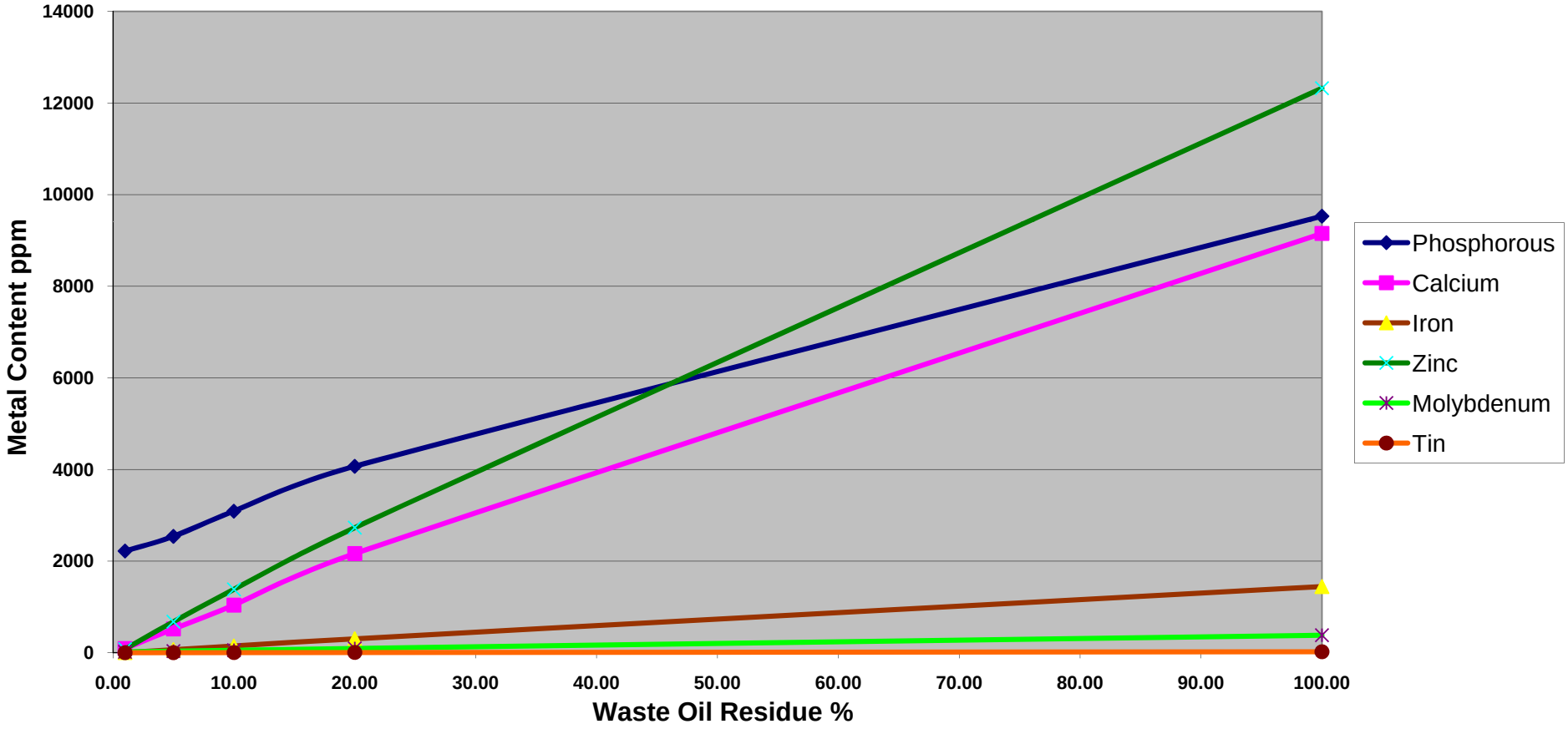


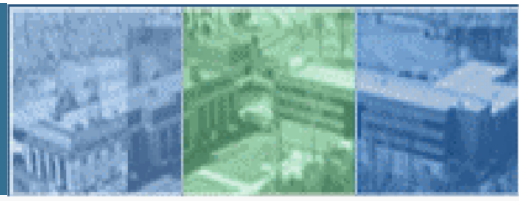
Lubricating Oil Additives Contain: Zinc, Phosphorous, Calcium





Detection of Recycled Engine Oil Bottoms in Asphalt Binders



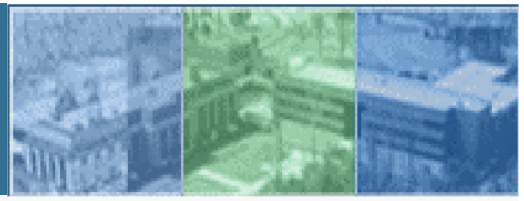


Crumb Rubber Modified Asphalt

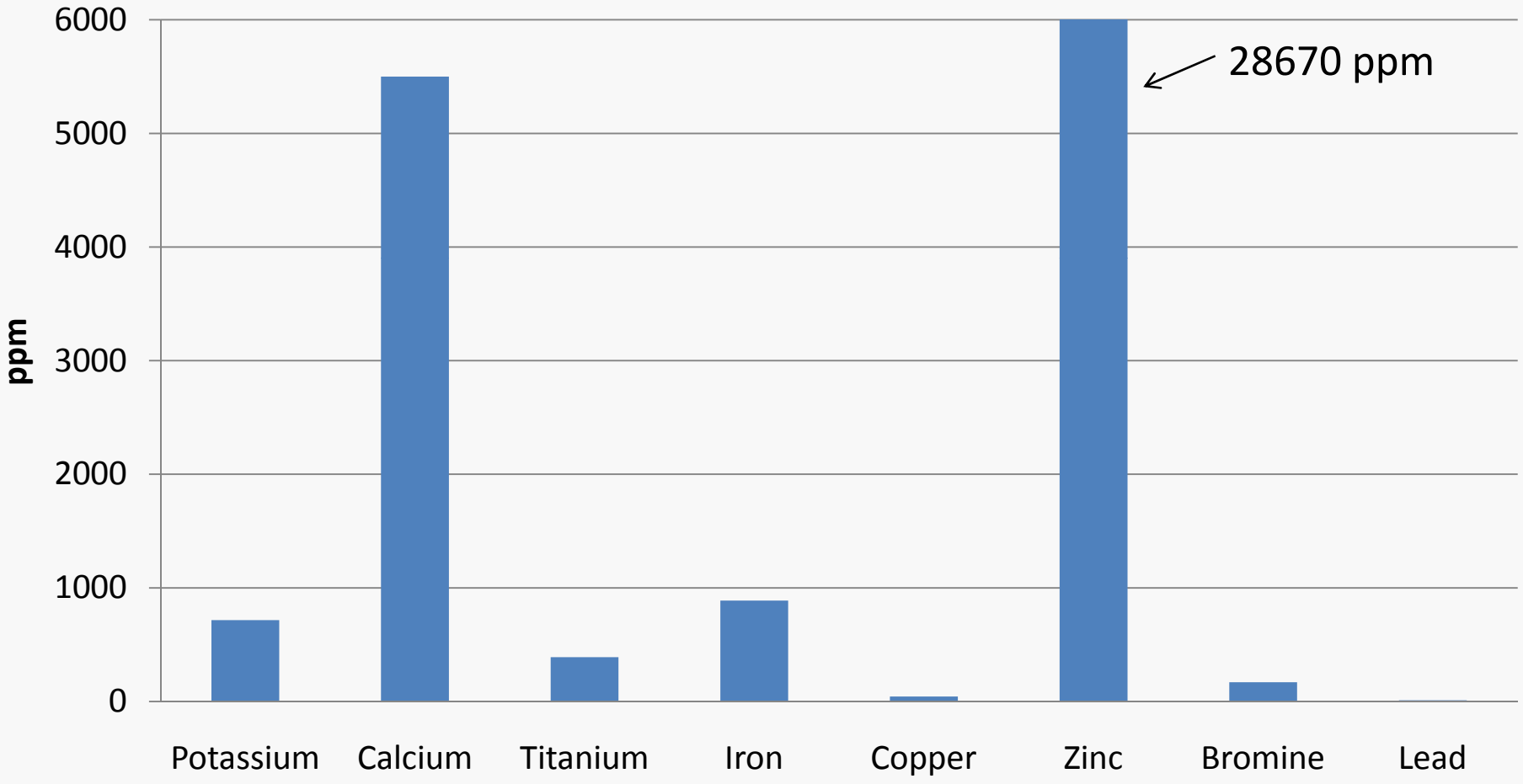
- The main activator used to assist in the Vulcanization of Rubber is Zinc (Zn)

- Crumb Rubber also contains:

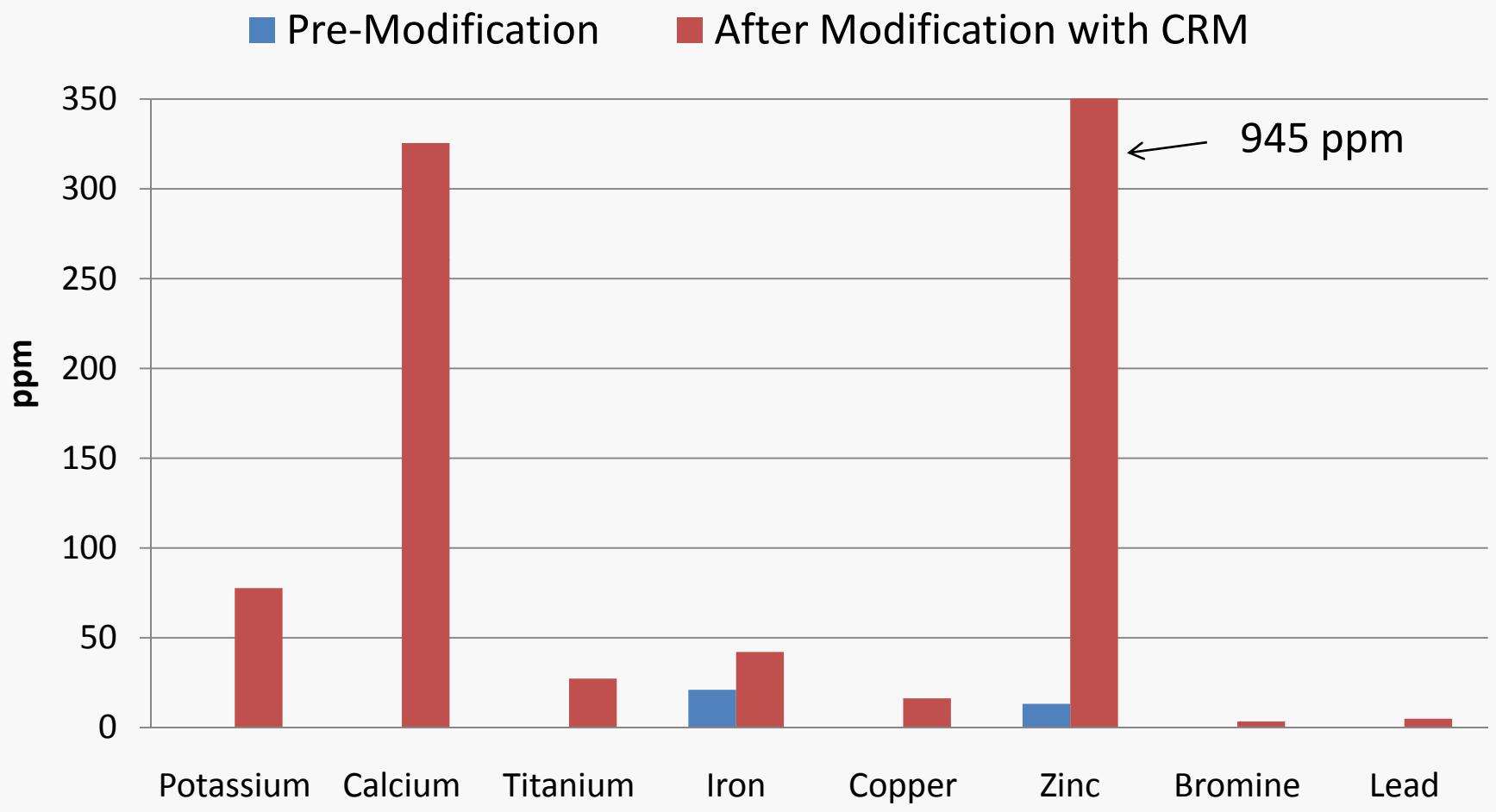
  Calcium (Ca)
  Iron (Fe)
  Copper (Cu)
  Lead (Pb)
  Potassium (K)
  Titanium (Sn)
  Bromine (Br)



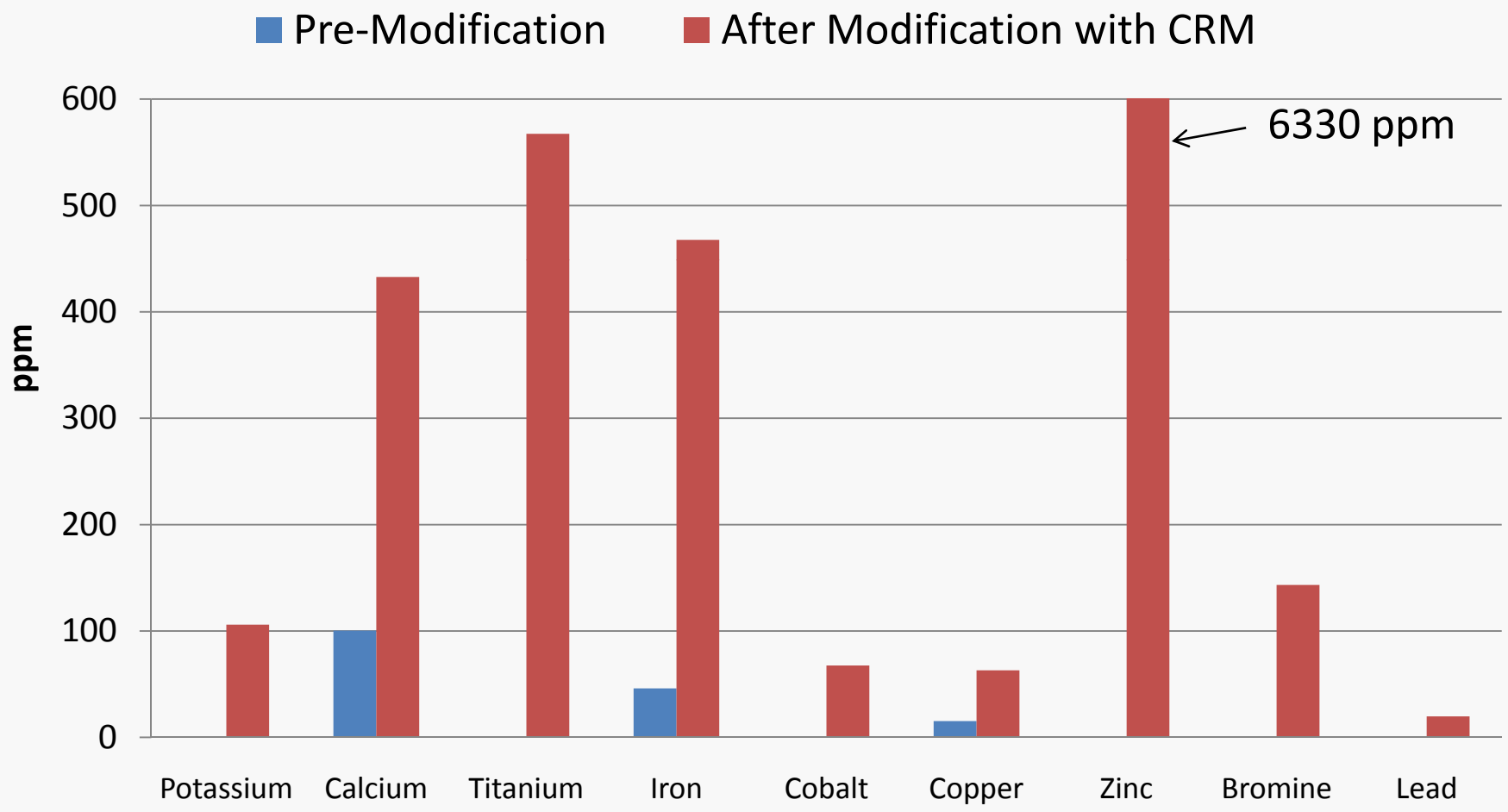
Crumb Rubber

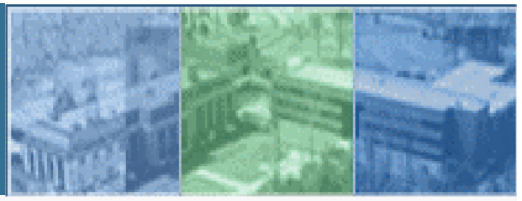


Terminal Blend Crumb Rubber Asphalt



Arizona Crumb Rubber Asphalt



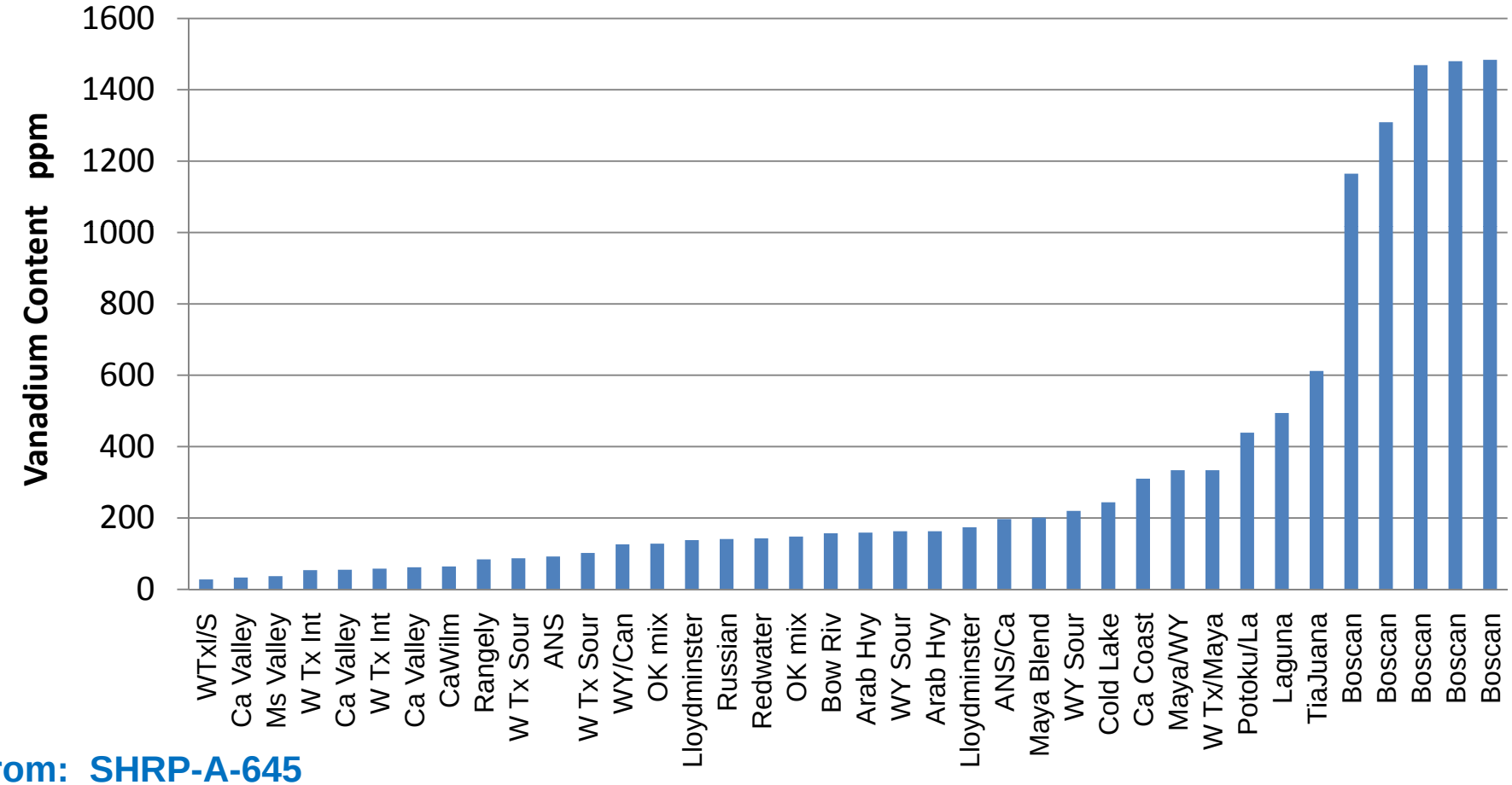


Can XRF help with Forensic Analysis?

Is the asphalt in the pavement the same as the binder the lab tested?

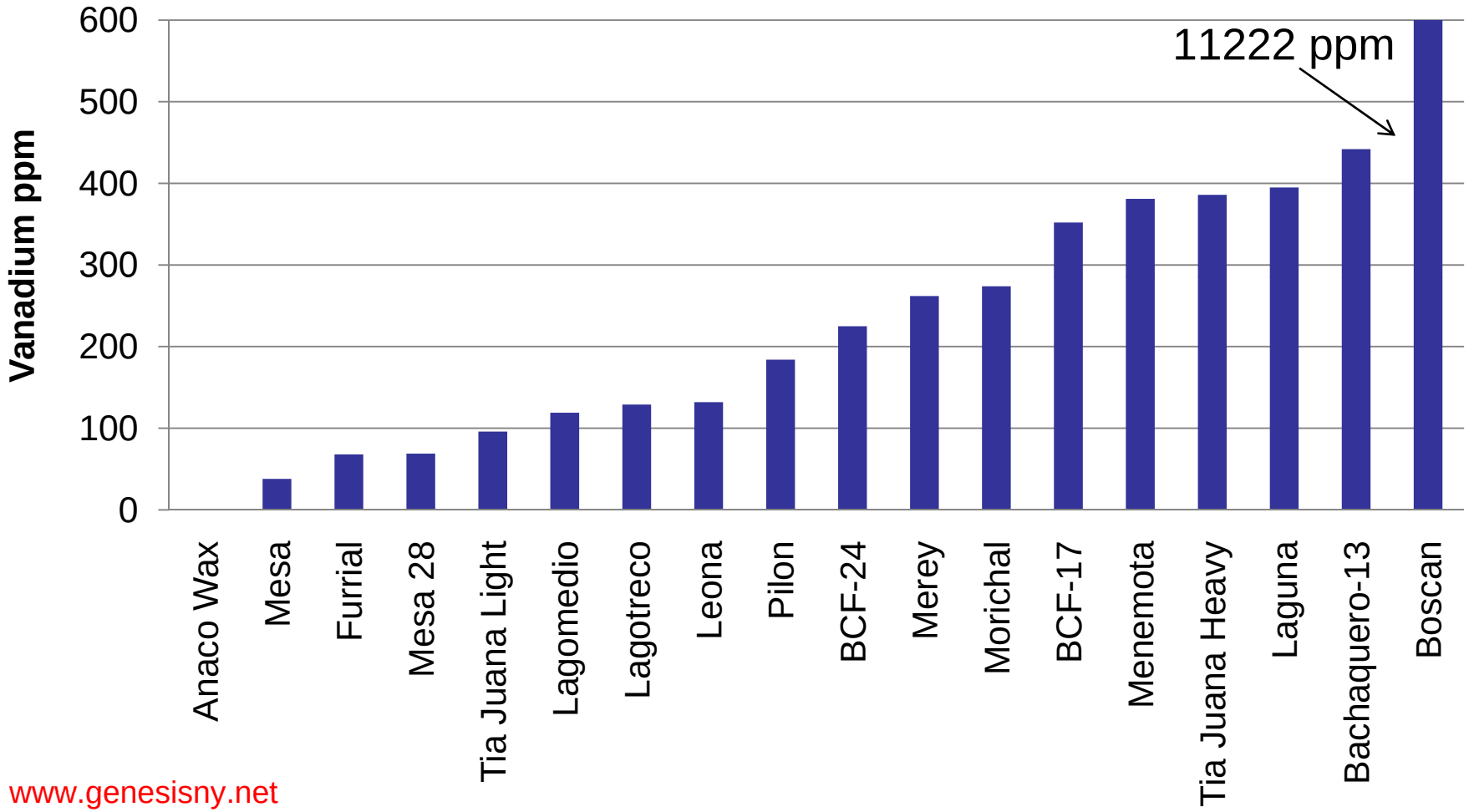
How would you know?

Vanadium Levels in SHRP Core Asphalts by Inductively Coupled Plasma (ICP) Emission Spectrometry

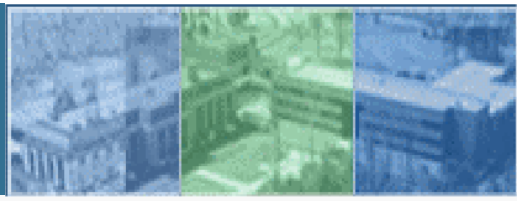


From: SHRP-A-645

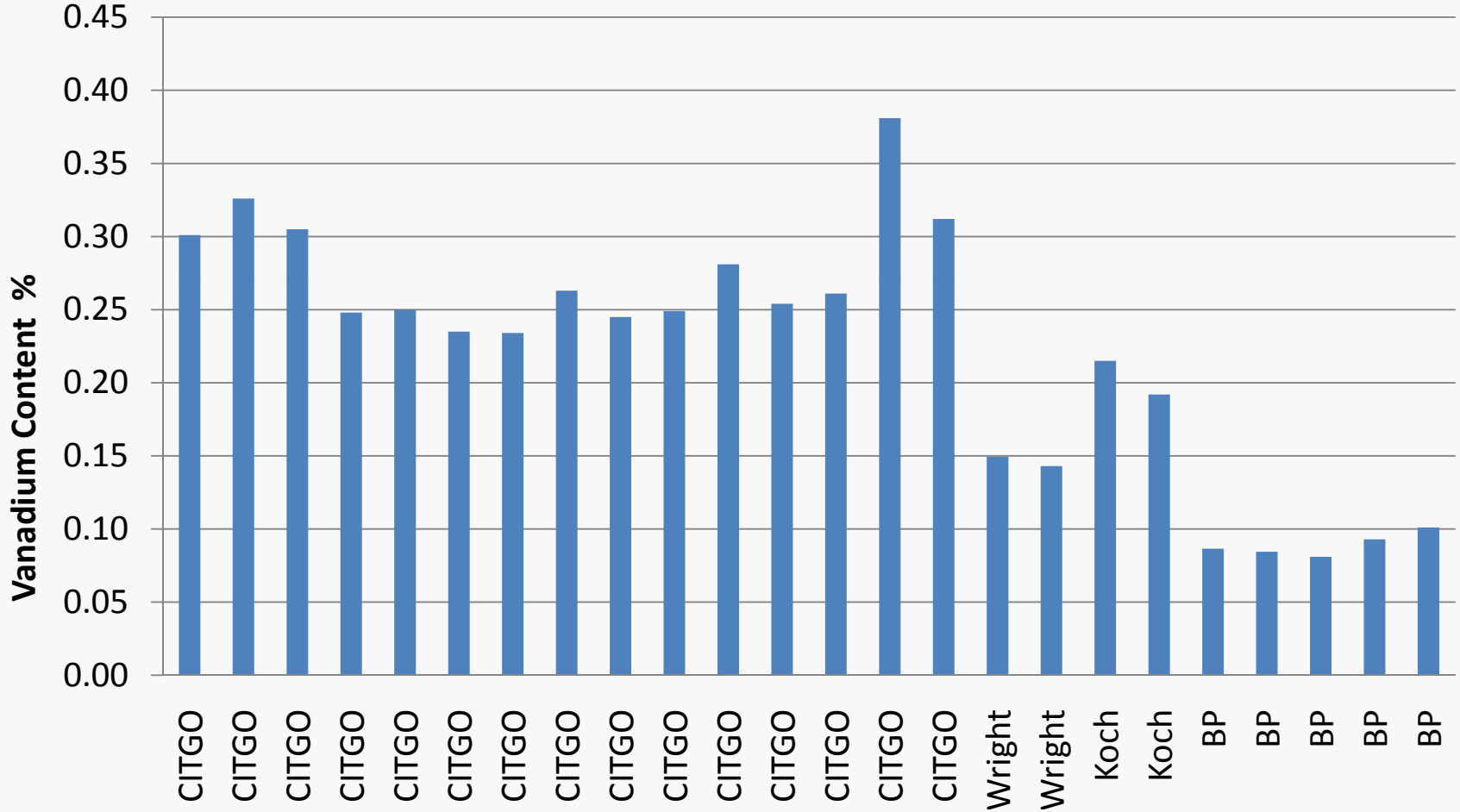
Vanadium Levels in Venezuela Crude



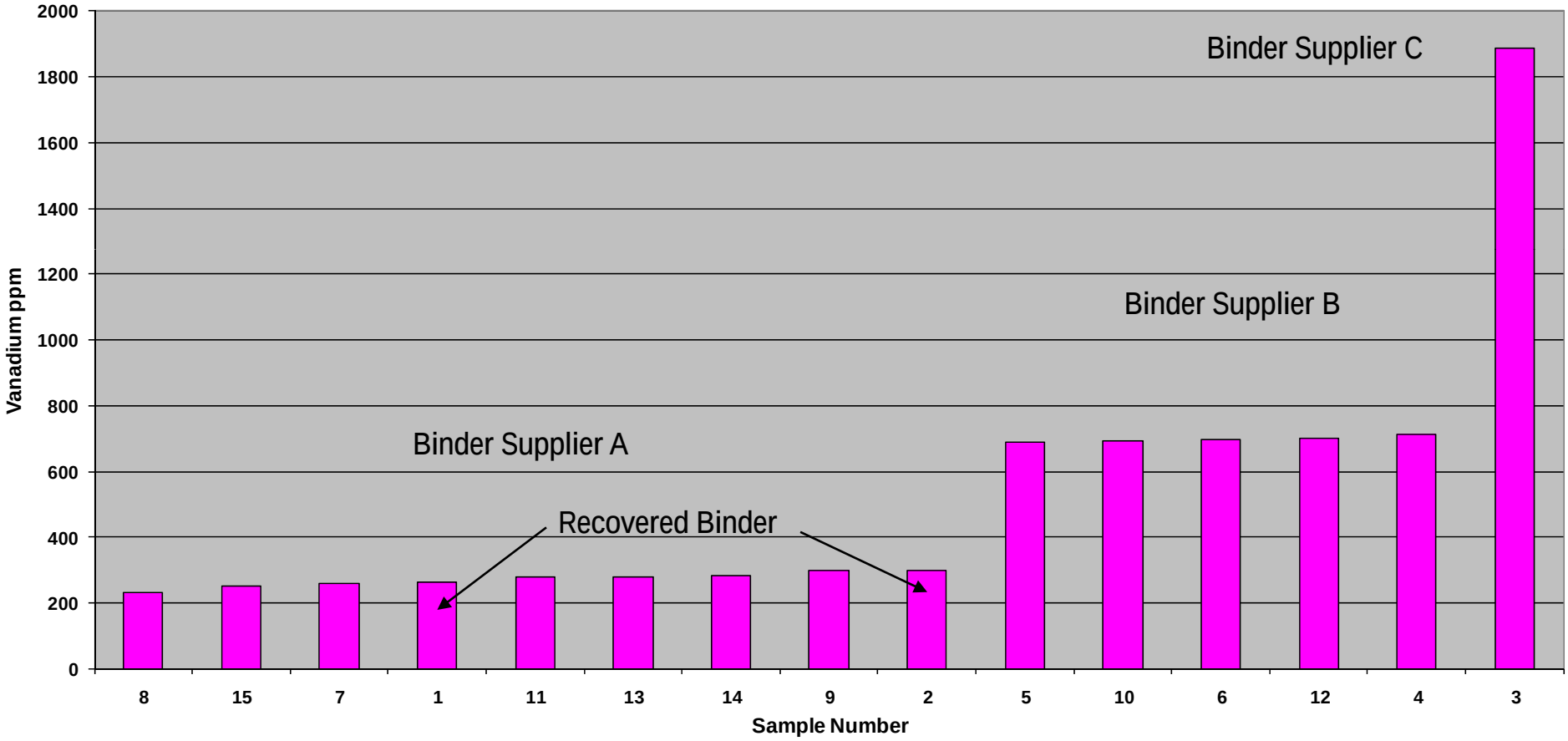
www.genesisny.net

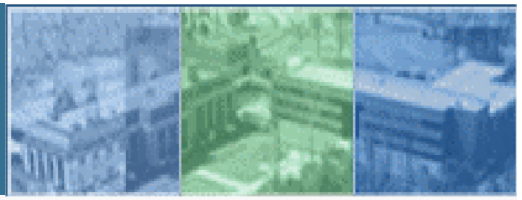


Vanadium Levels in ALF Lanes

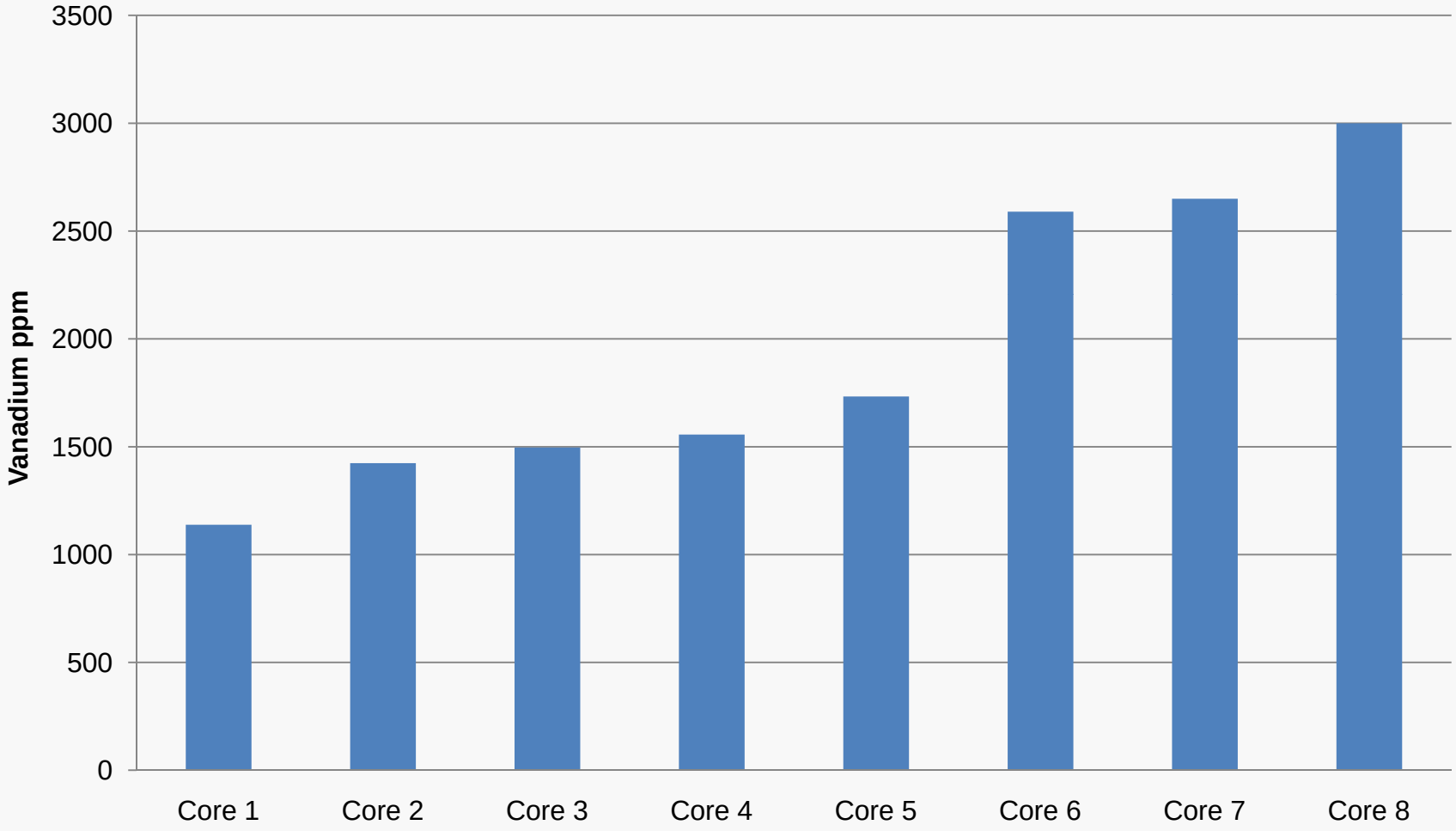


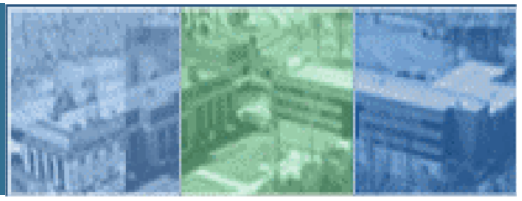
Vanadium Content of Binders - Forensic Study



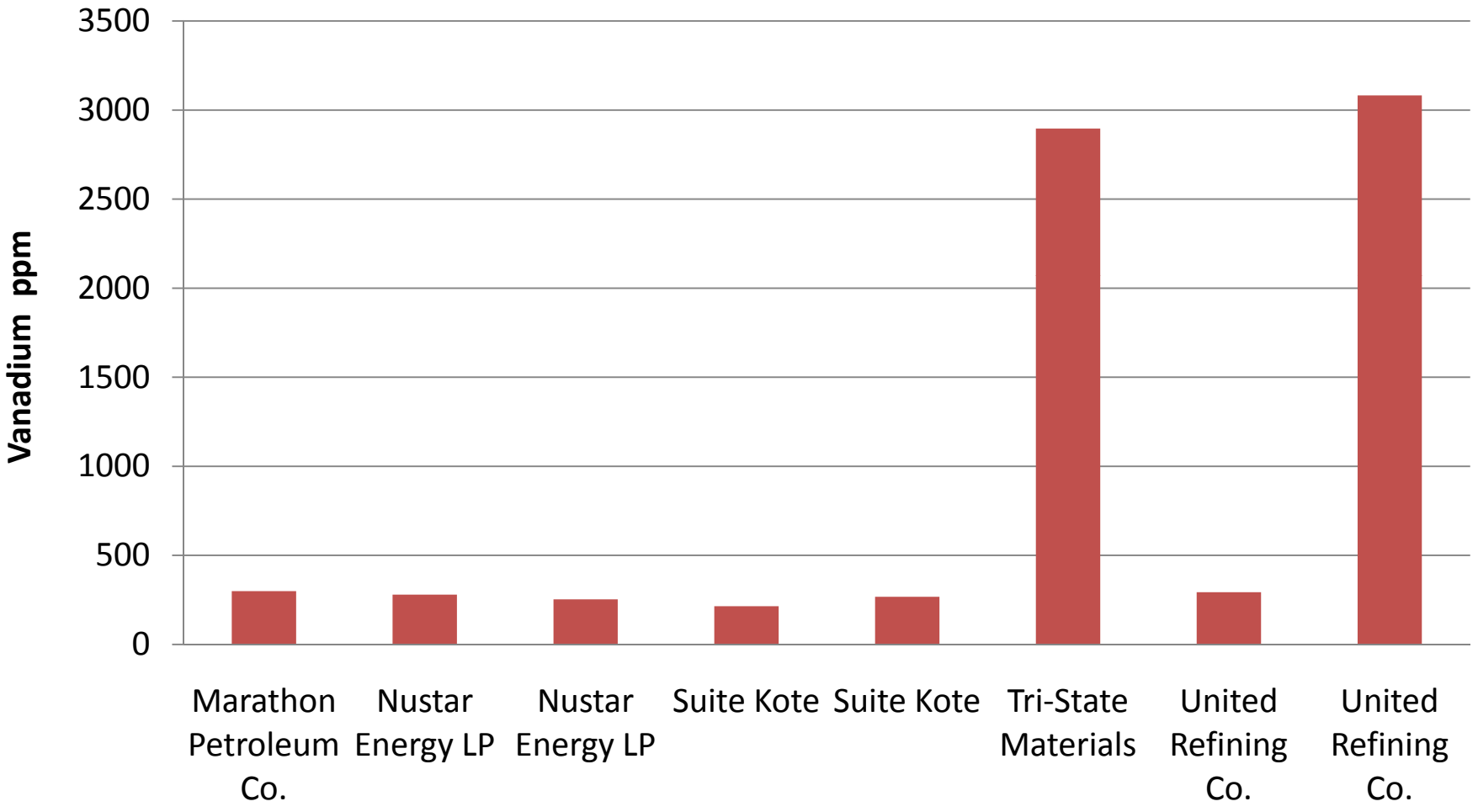


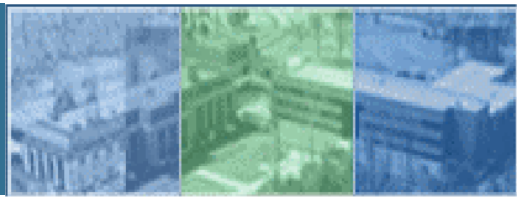
Vanadium Levels in New Hampshire Cores





Vanadium Content

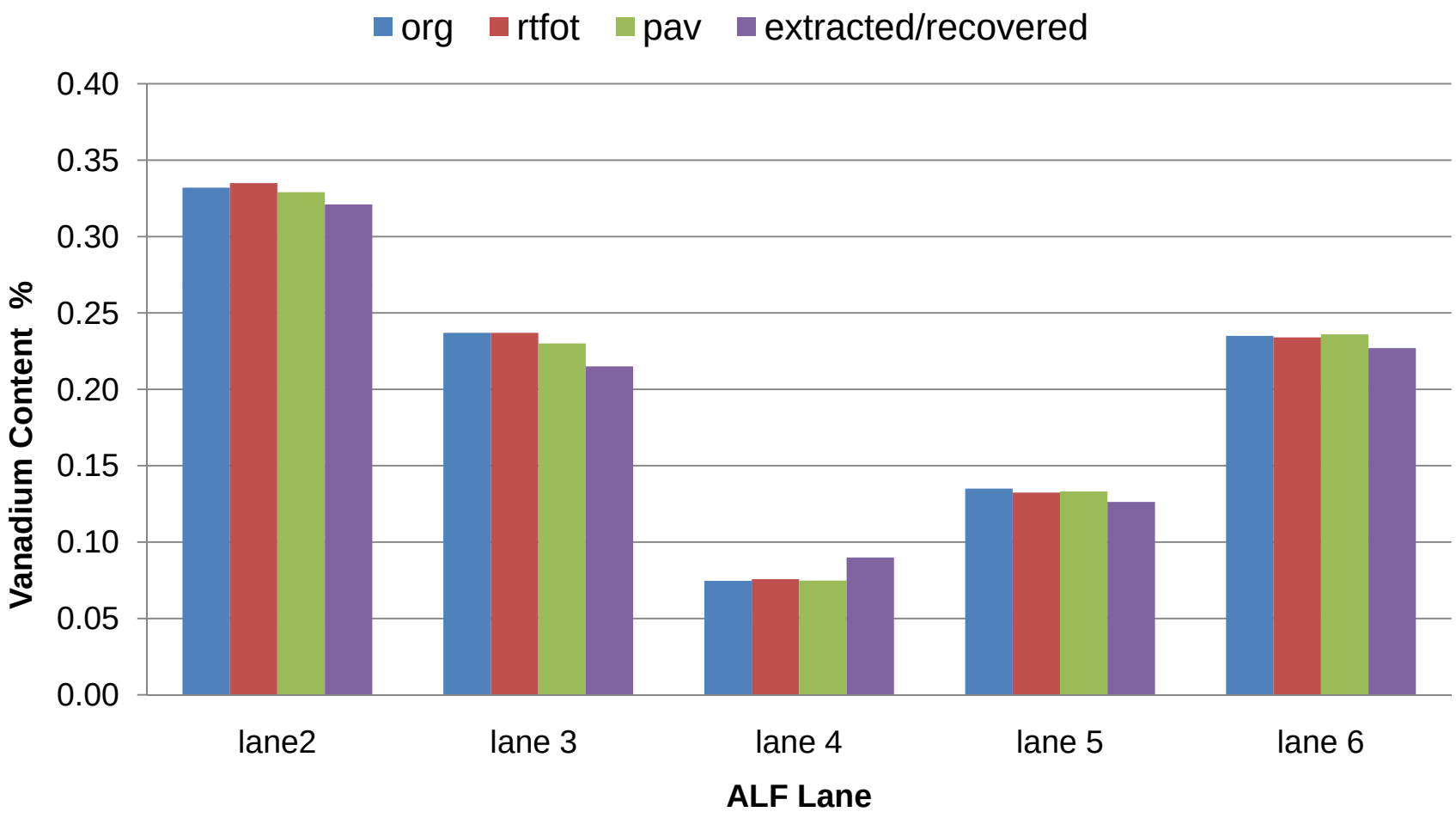


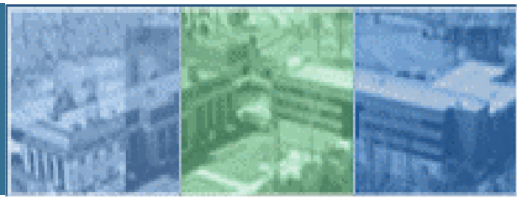


Vanadium Level in Asphalt is Unaffected by:

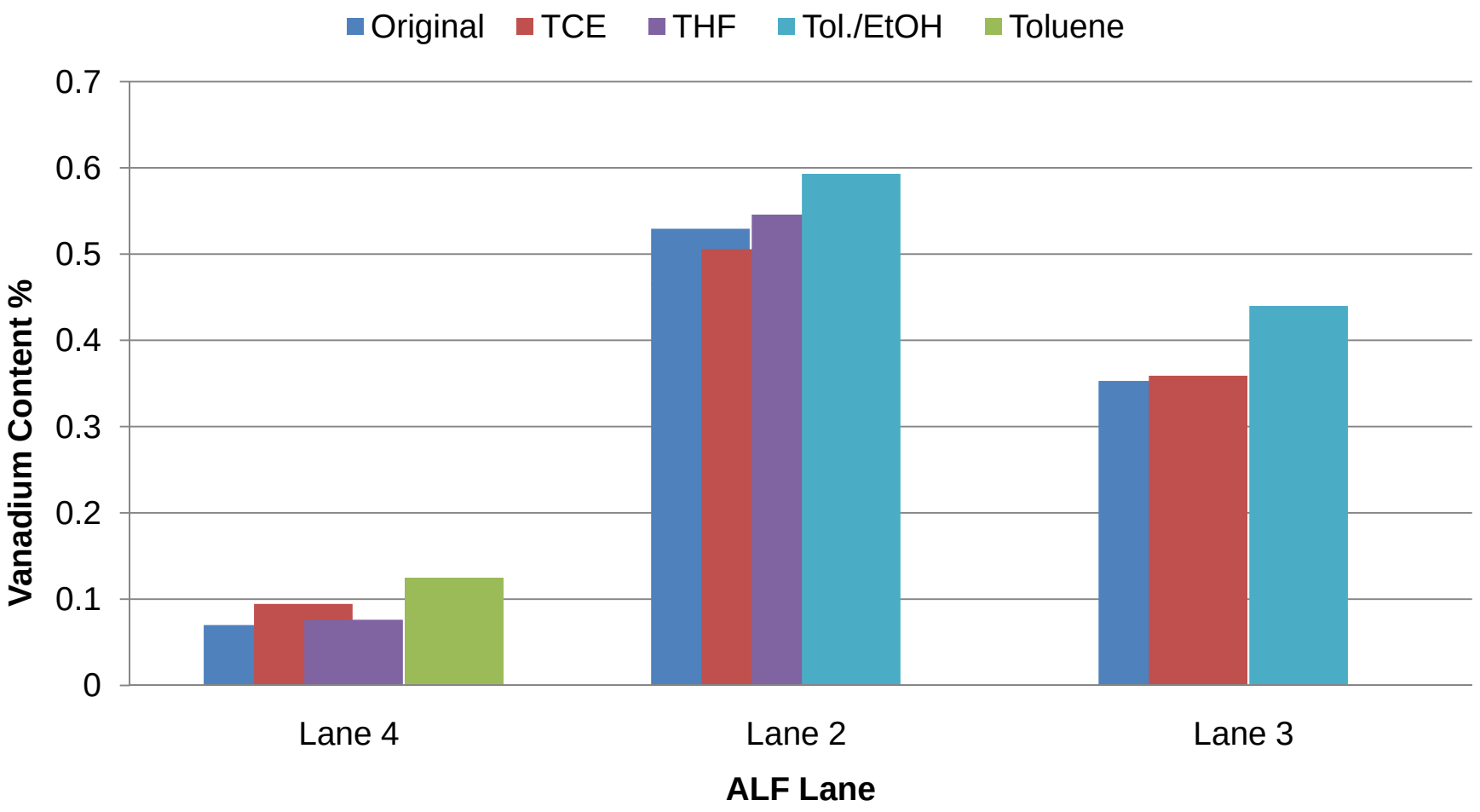
- Aging
- Extraction/Recovery Process
- Recovery Solvent
- Aggregate type

Vanadium Levels of Aged and Extracted/Recovered Binders

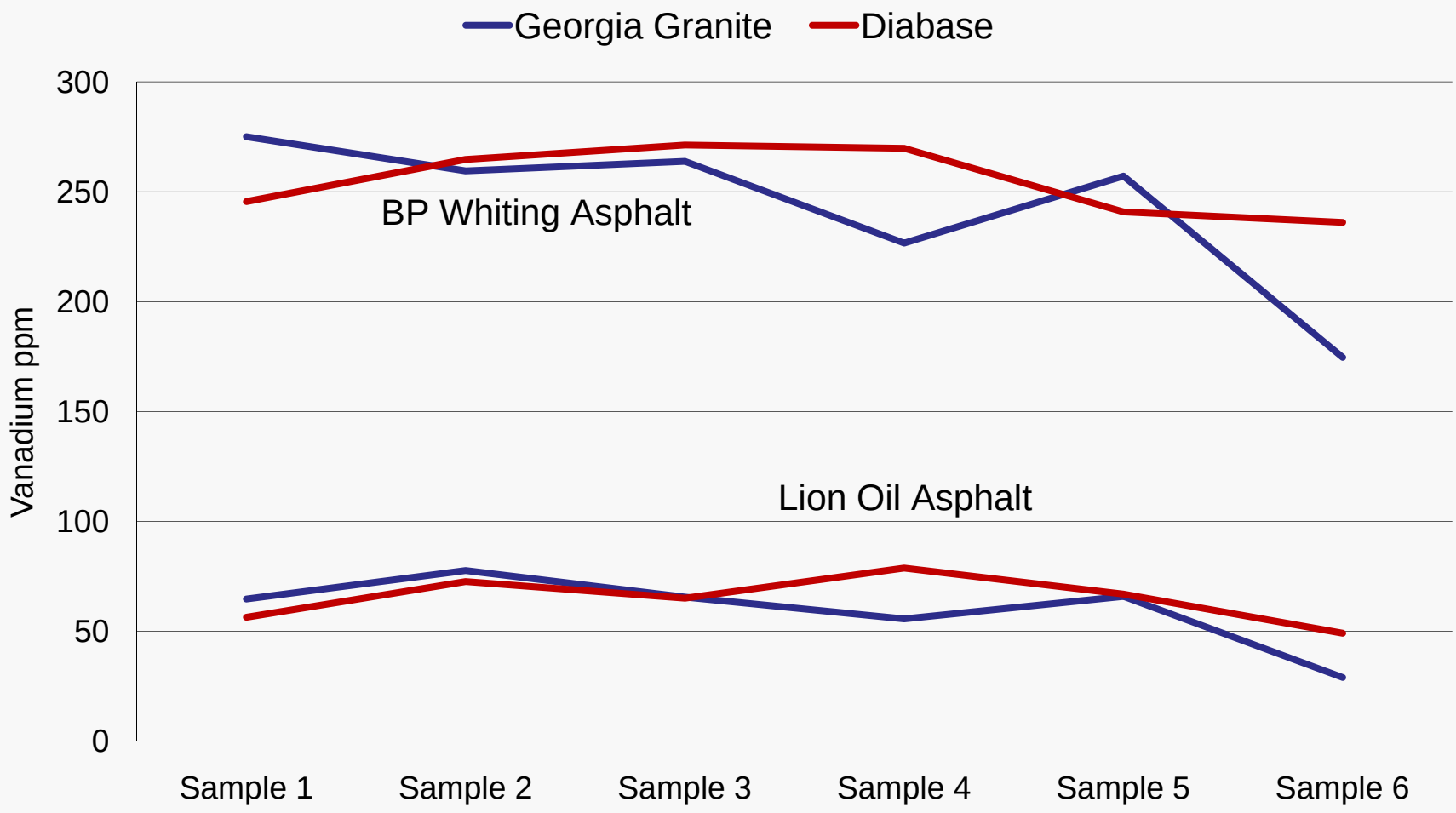


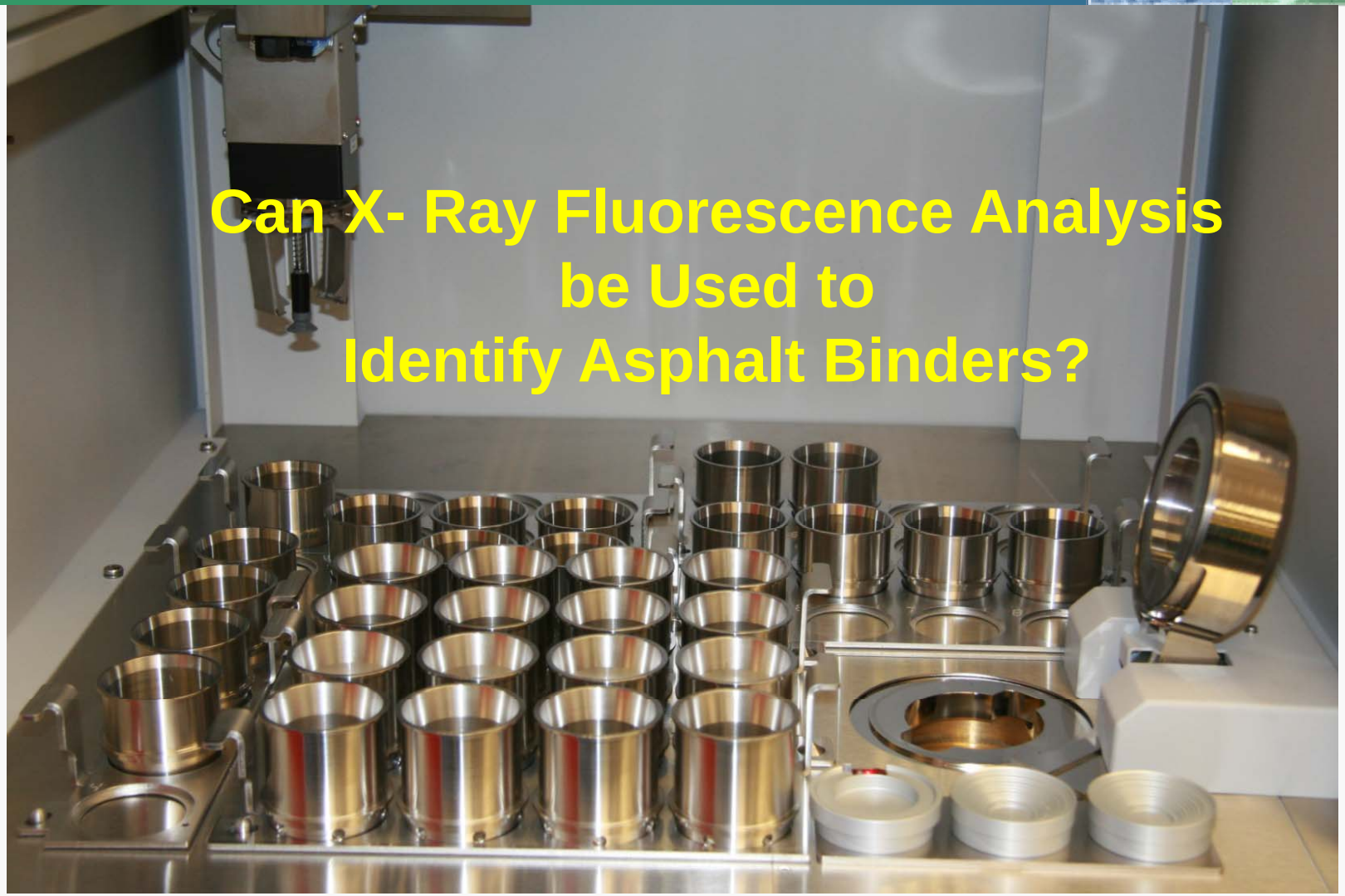


Effect of Recovery Solvent



Effect of Aggregate Type on Vanadium Content





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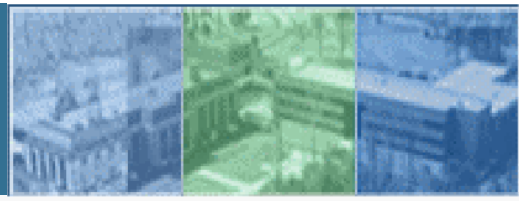
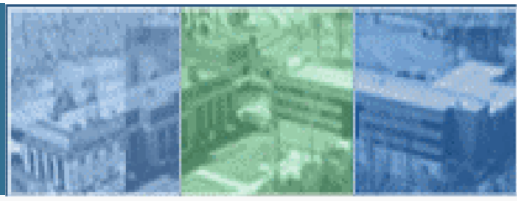


XRF Can Identify:

	P	Ca	K	Fe	Ti	Cu	Br	Pb	Zn	Mo	Sn
PPA Modified Asphalt	X										
Recycled Engine Oil Bottoms	X	X		X					X	X	X
Crumb Rubber Modified Asphalt		X	X	X	X	X	X	X	X		



SOMETIMES XRF Can :

Distinguish Between Two Asphalts

Indicate An Asphalt Source

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